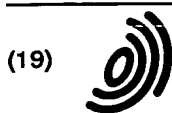


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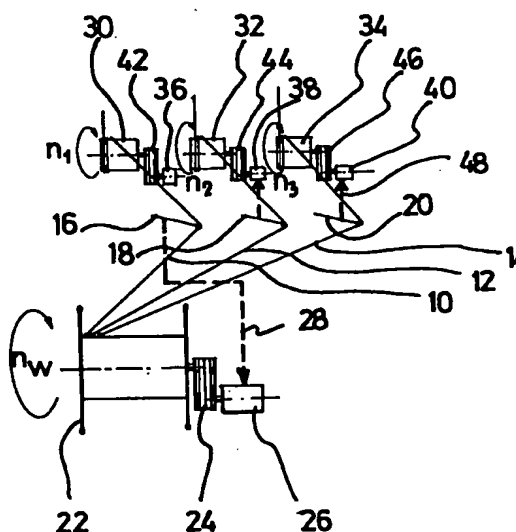
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(54) Winding of multiple filaments

(57) An assembly for winding a plurality of elongated elements (10, 12, 14) on a single spool (22) comprises :

- a set of independently driveable capstans (30, 32, 34), one for each individual elongated element to be wound ;
- a single spool (22) where the plurality of elongated elements (10, 12, 14) are to be wound ;
- first monitoring means (18, 20) for measuring the tensions of each individual elongated element of a subgroup (12, 14) of said plurality of elongated elements ;
- first control means (48) for steering individually the revolution speed (n_2 , n_3) of the capstans (32, 34) driving the elongated elements (12, 14) of said subgroup such that said tensions remain substantially constant and equal to each other.

FIG.1



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Description

Field of the invention.

The present invention relates to an assembly for winding a plurality of elongated elements on a single spool.

The terms 'elongated elements' refer to elements the longitudinal dimension of which is more than hundred times larger than the cross-sectional dimensions. Common examples of elongated elements are round or flat steel wires, steel cords, textile yarns, copper strands, ...

Background of the invention.

Assemblies and apparatus for winding a plurality of elongated elements such as wires, cables or cords on one single spool are known in the art.

However, the unwinding of a plurality of elongated elements from such a single spool, may cause difficulties and the subsequent twisting of the elongated elements, e.g. in a double-twisting machine, may lead to an unacceptable degree of fractures and processability problems.

The unwinding difficulties and the processability problems and fractures during the subsequent twisting may be due to a variation in diameter of the elongated elements during their winding, or may be due to the fact that elongated elements become entangled during their winding, or may be due to the fact that the elongated elements, although wound at the same time on the same spool, take different lengths on the spool.

GB-B-1 163 983 discloses a method for winding a plurality of elongated elements on one single spool whereby it is aimed at keeping the winding lengths of the elongated elements substantially equal to each other despite some variations in diameter of the elongated element. The solution used to obtain substantially the same lengths is to increase the tension in elongated elements with an increased diameter in order to reduce the winding diameter and to decrease the tension in elongated elements with a decreased diameter in order to increase the winding diameter.

Summary of the invention.

It is an object of the present invention to provide for an alternative system for winding a plurality of elongated elements on a single spool such that unwinding causes no substantial problems.

It is a further object of the present invention to provide for a system for winding a plurality of elongated elements on a single spool such that twisting subsequent to unwinding causes no substantial problems.

According to the present invention there is provided for an assembly for winding a plurality of elongated elements on a single spool. The assembly comprises following parts :

- a set of independently driveable capstans, one for each individual elongated element to be wound ;
- a single spool where the plurality of elongated elements are to be wound ;
- first monitoring means for measuring the tensions of each individual elongated element of a subgroup of the plurality of elongated elements ;
- first control means for steering individually the revolution speed of the capstans driving the elongated elements of the subgroup such that said tensions remain substantially constant and substantially equal to each other.

By keeping the tensions in the elongated elements substantially constant and equal the inventors have experienced that the majority of unwinding difficulties and subsequent twisting problems have been overcome.

Two alternative assemblies according to the invention exist.

In a first alternative the assembly further comprises second monitoring means for measuring the tension of one individual elongated element which does not belong to the subgroup. The revolution speed of the single spool is steered such that the tension of this individual element remains substantially constant and substantially equal to the tension of the elements of the subgroup.

In a second alternative all the individual elongated elements belong to the subgroup, and the revolution speeds of all the corresponding individual drive capstans is steered such that the tensions in all the individual elongated elements remain substantially constant and substantially equal to each other.

In a preferable embodiment of the invention the system further comprises grouping means for bringing the elongated elements parallel adjacent to each other before their winding. These grouping means prevent the elongated elements from jumping over each other and from entangling with each other. These grouping means together with the means for keeping the tensions in the elongated elements substantially constant and equal result in substantially equal lengths wound upon the single spool.

In another preferable embodiment of the invention the assembly further comprises means for realizing a to and fro movement lengthwise of the single spool and relative to the single spool, means for measuring an accumulation of that elongated element that is nearest to one of said ends of the single spool and means for automatically reversing the movement towards the other of said ends of said single spool upon an accumulation being detected. The to and fro movement is 'relative' to the spool, which means that either the elongated elements are moved with respect to the spool or that the spool is moved with respect to the elongated elements.

Brief description of the drawings.

The invention will now be described into more detail with reference to the accompanying drawings wherein

- FIGURE 1 schematically shows a first assembly according to the invention ;
- FIGURE 2 schematically shows a second assembly according to the invention.

Description of the preferred embodiments of the invention.

FIGURE 1 illustrates three wires 10, 12, 14 the tension of which is measured by passing them respectively over individual dancer arms 16, 18, 20 before winding them simultaneously on a single spool 22. Spool 22 is driven via a belt 24 by an electric motor 26. The position of dancer arm 16 determines the revolution speed of electrical motor 26, and, as a consequence, of revolution speed n_w of the spool 22, in a way well known in the art such that the tension of wire 10 remains substantially constant. This control of the speed of electrical motor 26 is indicated by a hatched arrow 28.

The wires 10, 12, 14 are individually driven by distinct capstans 30, 32, 34 which are in their turn driven respectively by electrical motors 36, 38, 40 by means of belts 42, 44, 46. The position of dancer arms 18 determines the revolution speed of electrical motor 38, and as a consequence revolution speed n_2 , such that the tension of wire 12 remains substantially constant and substantially equal to the tension of wire 10. The position of dancer arms 20 determines the revolution speed of electrical motor 40, and as a consequence revolution speed n_3 , such that the tension of wire 14 remains substantially constant and substantially equal to the tension of wire 10.

The revolution speed n_1 of wire 10, the tension of which determines the revolution speed n_w of spool 22, is adjusted beforehand.

FIGURE 2 illustrates an alternative way of winding three individual wires 10, 12, 14 on a single spool 22. The main difference with the assembly as illustrated under FIGURE 1, is that in the assembly of FIGURE 2 all the revolutions speeds n_1 , n_2 and n_3 are determined, at least indirectly, by the position of dancer arms 16, 18 and 20 while revolution n_w of spool 22 is adjusted beforehand.

After passing over dancer arms 16, 18, 20, the individual wires 10, 12, 14 are brought together parallel adjacent to each other by means of sets of guiding pulleys 50, 52 and, for example, by means of a comb 54 before their winding on spool 22. This bringing together of the individual wires into a set of parallel wires is done to prevent the wires from entangling with each other and from jumping over each other.

In order to obtain a full spool 22 with a uniform winding between the flanges, possible accumulation 56 of the left wire 10 that is nearest to the left flange is monitored and once an accumulation near the left flange is detected, e.g. by detecting a raise in the tension of wire 10, the to and fro movement lengthwise of the spool is reversed from the right to left direction to the left to right direction, which is indicated by arrows 58 and 60. In a

similar way, possible accumulation 62 of the right wire 16 that is nearest to the right flange is monitored and once an accumulation near this right flange is detected, e.g. by detecting a raise in the tension of wire 16, the to and fro movement lengthwise of the spool is reversed from the left to right direction to the right to left direction, which is indicated by arrows 64 and 66. A wire winding system for obtaining a uniform winding for one single wire has been disclosed into more detail in US-A-3,967,787. The present invention differs herefrom that a plurality of wires are wound on the spool on that accumulation near the right flange is only monitored on the right wire (which is nearest to the right flange) and that accumulation near the left flange is only monitored on the left wire (which is nearest to the left flange).

Individual wire drawing machines, multiple wire drawing machines or the unwinding of individual wires from spools may be situated upstream of the assemblies according to the invention.

Spools wound according to the present invention with a plurality of steel filaments have already been used in the manufacture of steel cords. The double-twisting of a 1x3 steel cord and of a 2+2 steel cord was done without increase of fractures and without substantial processability problems.

Spools wound with steel filaments according to the present invention have equal lengths of the steel filaments wound on the spool. This can be derived from the experiment that when all the steel filaments which are wound on the same spool, are unwound over several meter and under the same tension, they all exhibit the same looseness. Such spools with multiple steel filaments of substantially the same length can be used without substantial problems in the braiding of steel filaments for reinforcement of rubber hoses.

Spools wound with a multiple of steel filaments or with a multiple of steel cords according to the present invention can also be advantageously used in the manufacturing process of rubber tires. Conveniently large creels comprising a high number of spools are used in the manufacture of rubber tires. Use of spools with multiple filaments or with multiple cords greatly reduces the size of the creels and the fact that the filaments or cords have been wound under substantially the same tension parallel to each other means that no entanglement has occurred and that subsequent unwinding poses no great difficulties.

In order to simplify the description and the drawings the invention has been explained taking as example the multiple winding of only three elongated elements. Extension to five, eight, ten, fifteen or even more elongated elements is within the normal activities of a man skilled in the art.

Claims

1. An assembly for winding a plurality of elongated elements on a single spool, said assembly comprising :

- a set of independently driveable capstans, one for each individual elongated element to be wound ;
 - a single spool where the plurality of elongated elements are to be wound ; 5
 - first monitoring means for measuring the tension of each individual elongated element of a subgroup of said plurality of elongated elements ;
 - first control means for steering individually the revolution speed of the capstans driving the elongated elements of said subgroup such that said tensions remain substantially constant and substantially equal to each other. 10
- 15
2. An assembly according to claim 1
said assembly further comprising :
- second monitoring means for measuring the tension of one individual elongated element not belonging to said subgroup ; 20
 - second control means for steering the revolution speed of said single spool such that said measured tension remains substantially constant and substantially equal to the tension of the elongated elements of the subgroup. 25
3. An assembly according to claim 1
wherein said subgroup comprises all of said elongated elements. 30
4. An assembly according to any of the preceding claims
said assembly further comprising grouping means for bringing said elongated elements parallel adjacent to each other. 35
5. An assembly according to any of the preceding claims
said assembly further comprising means for realizing a to and fro movement lengthwise of said single spool, means for measuring an accumulation of the elongated element that is nearest to one of said ends of said single spool and means for automatically reversing the movement towards the other of said ends of said single spool upon an accumulation being detected. 40
- 45
- 50
- 55

FIG.1

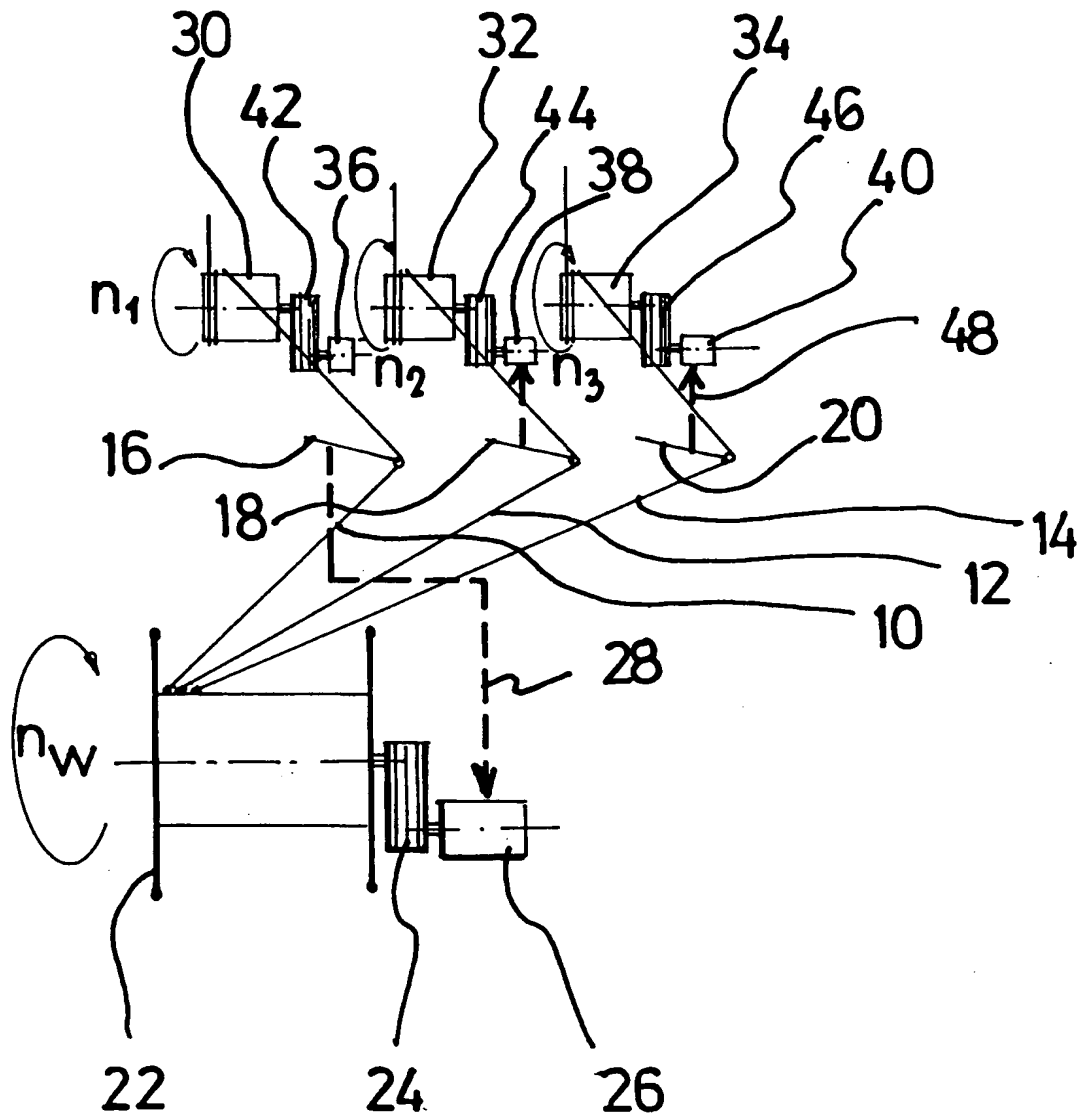
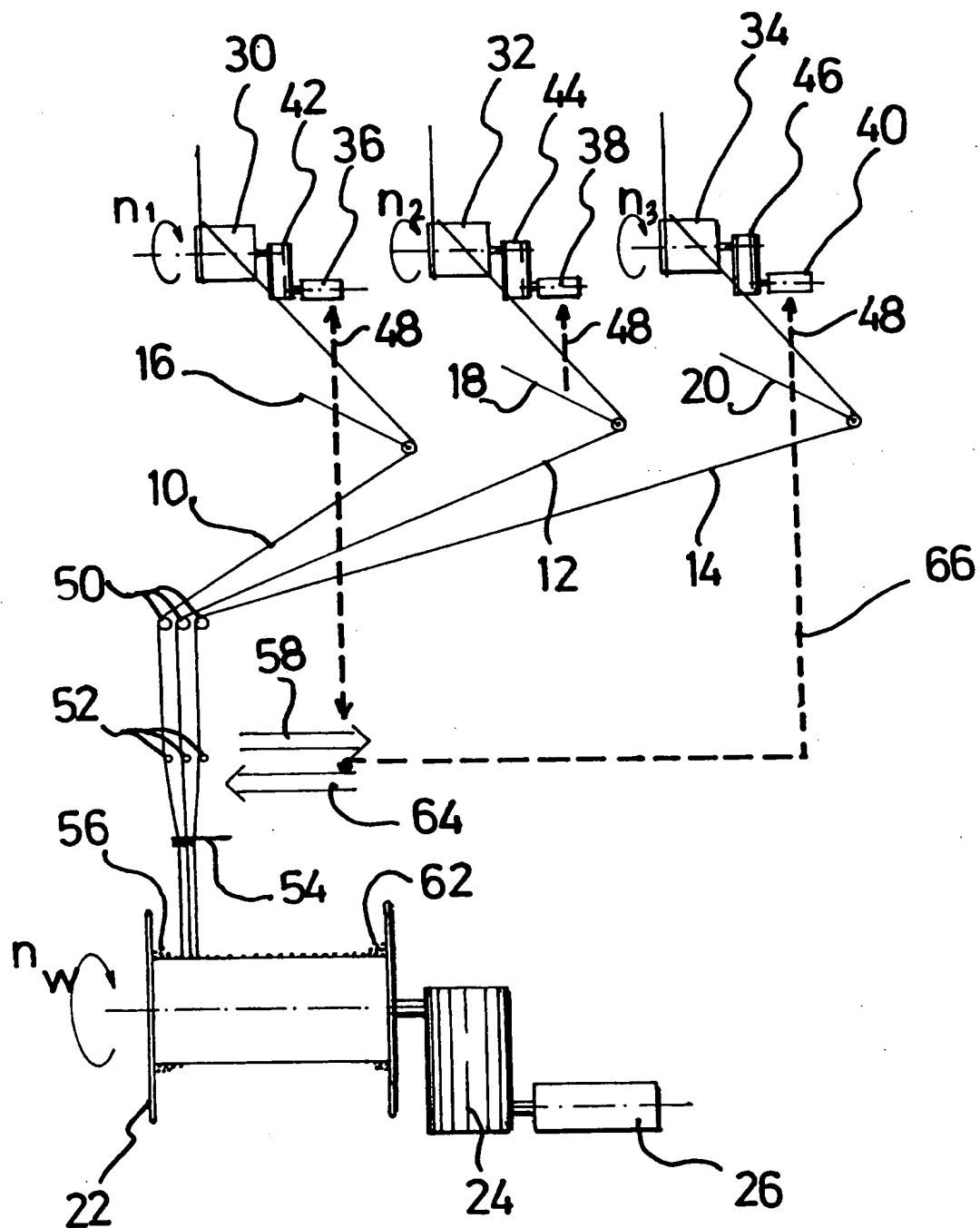


FIG. 2





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 3536

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE-A-28 12 100 (BARMAG BARMER MASCHINENFABRIK)	1-4	B65H59/38
Y	* page 15, line 20 - page 16, line 28 * * page 18, line 10 - line 17; figures *	5	
Y,D	US-A-3 967 787 (MULLEMAN)	5	
A	* claim 1; figures *	1	
A	EP-A-0 476 880 (GENERAL ATOMICS) * column 7, line 5 - column 8, line 51; figures *	1	
A	FR-A-1 549 653 (TRÉFILIERIES LÉON BEKAERT) * page 4, right-hand column, line 7 - page 5, right-hand column, line 27; figure *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B65H
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 20 May 1996	Examiner Fuchs, H
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